Europa-Universität Flensburg

Impacts of electrification under the perspective of the Multi-Tier- Framework in Southern Tanzania

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00| Agenda

01| **Background** – Tanzania and the Mwenga Hydro Power Project

02| **Method**

03| **Results and Discussion**

04| **Conclusion & Outlook**

05| **References**

01| Background

Figures on Tanzania

- Average annual real GDP growth rate of 7% in the last decade [1]
- Population size amounts to 55.6 million people in 2016 [1]
- *Challenges:*

➢ Total life expectancy: 65 years in 2015[1]

➢ Human Development Index (HDI): Position 151 out of 188 [2, p.200)

➢ Multidimensional Poverty Index (MPI): 66.4% multi-dimensionally poor in terms of education, health and standard of living [2, p.219]

01| Background

Access to electricity

- Approx. 16% of the total population (urban: 41%; rural: 4%) [1]

FIGURE 2.8 Eighteen of the 20 least electrified countries boosted access rates in 2012–14

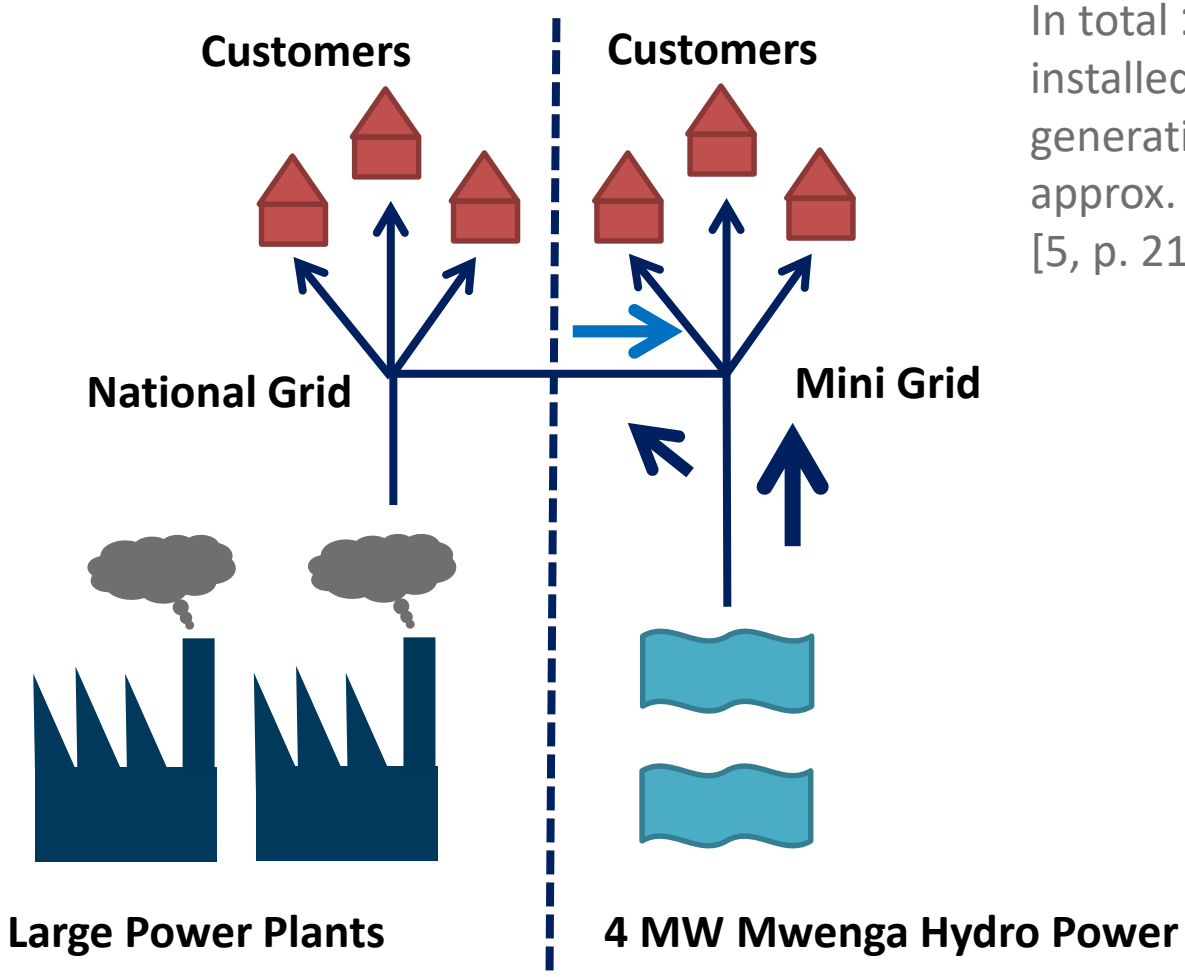
Access rate in 2014 (%) and annualized increase in access rate in 2012–14 (percentage points)

Source: [3, p.44]

01| Background

Tanzania and the Mwenga Hydro Power Project

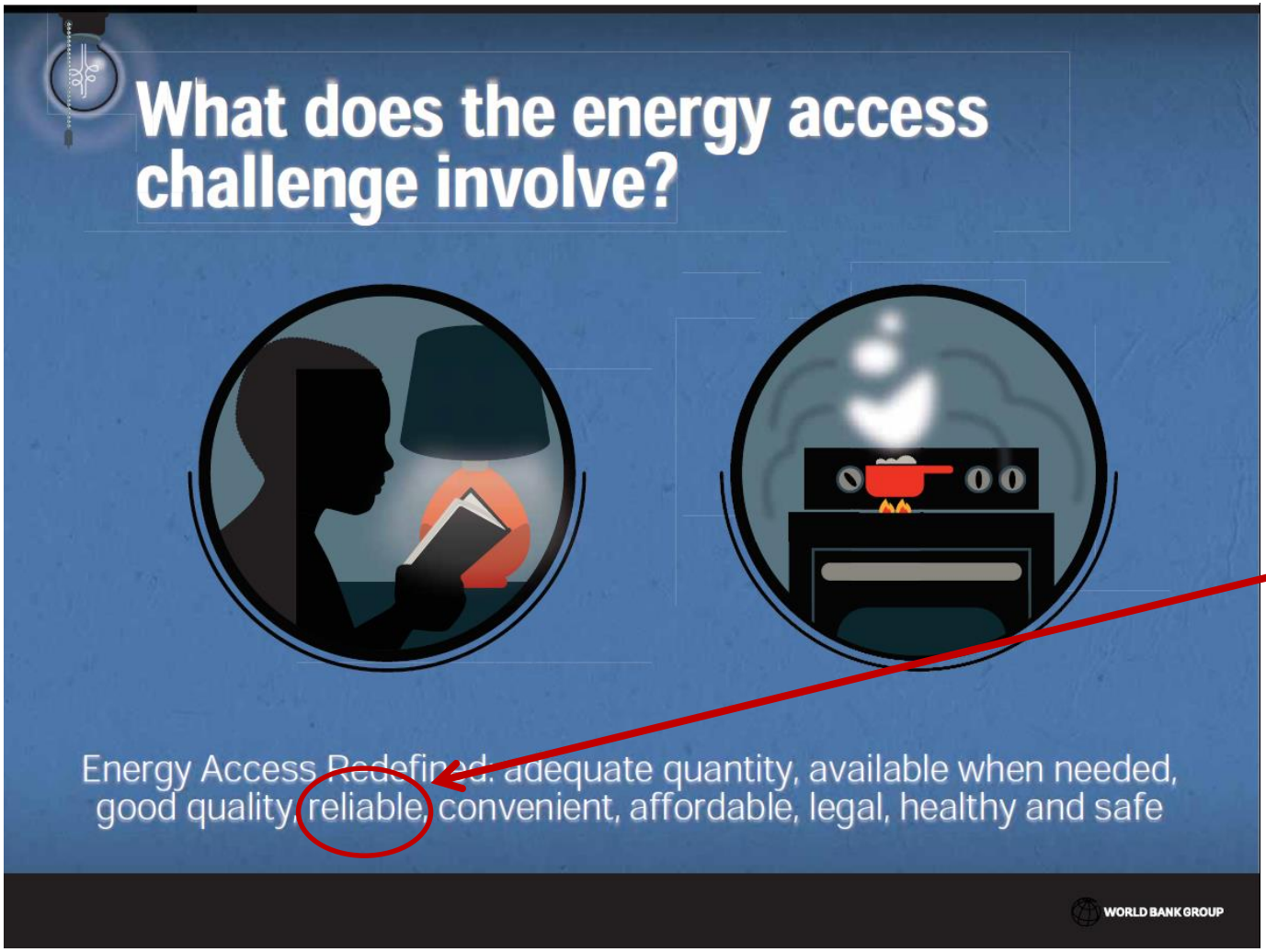
Total installed power generation capacity: **1564 MW**. [4,p.25]



In total **109** mini-grids, installed power generation capacity: approx. **157.7 MW**. [5, p. 21, p.23, p.25, p.30]

Source: own elaboration based on[6, p. 11]

Motivation – Multi-Tier-Framework – Energy Access redefined



Source: [7, p. 7]

No longer
a *binary* definition

"Reliability considers the frequency and length of interruptions to supply"

01| Background
Motivation

- Combination of both types of rural electrification and its impact on the socio-economic conditions surrounding the interconnected projects has rarely been studied
- Motivation to study the interconnection:

→ Off-grid (mini-grid) systems limit electricity supply; restricted capacity for productive investments

→ But also grid- connected areas suffer from capacity constraints (e.g. through frequent black-out or load shedding); also limits the expansion of productive uses

→ Off-grid systems are frequently threatened by future grid expansion plans and might therefore not be implemented at all → if interconnection "works well", there is motivation for future investors to invest in off- and mini-grid systems

02| Method

Definitions and assumptions

- Outages per day: in hours, differenced by source (between 7 pm and 6 am)
- Distribution: average kWh per day (between 7 pm and 6 am)
- Intermediary outcome of electrification: average lighting hours per day per household, based on survey data from 2015 [8]

03| Results and Discussion

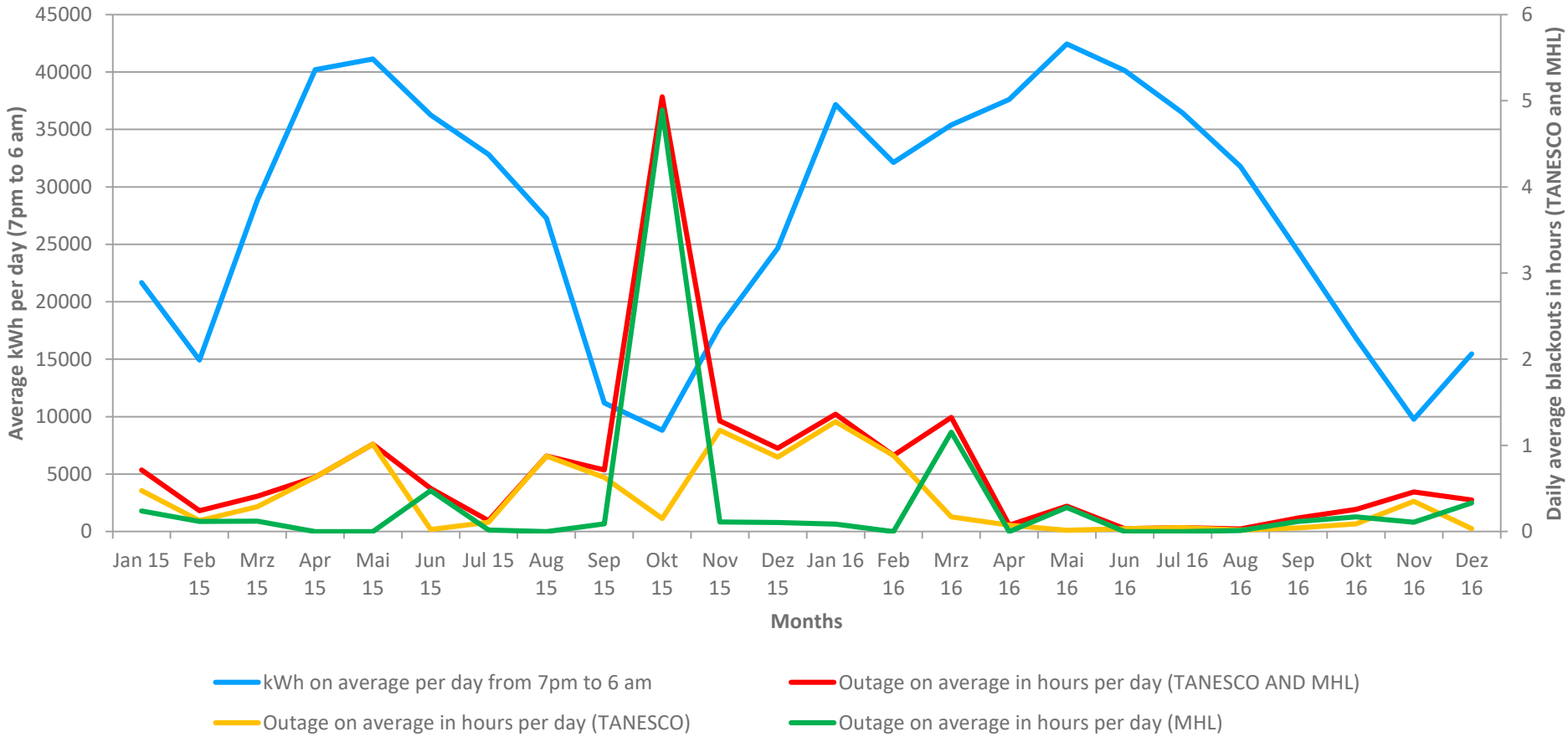
Daily average outages in hours from 7 pm to 6 am

	TANESCO outages	MHL outages	Both outages combined
2015	0.54 h	0.51 h	1.06 h
2016	0.26 h	0.19 h	0.45 h

Source: own calculation based on [9]

03| Results and Discussion

Outages and distributed kWh



Source: own elaboration based on [9]

03| Results and Discussion

Avergae lighting hours per day- Mini-grid connected area vs. not grid-connected area

	No outages considered	Both outages combined 2015	Both outages combined 2016	Tanesco outage 2015	Mwenga outage 2015	Tanesco outage 2015	Mwenga outage 2015
Mini-grid connected households	32.95 h	27.7	30.6	30.1	30.3	31.6	31.9
Not yet grid-connected households	23.94 h***	NA	NA	NA	NA	NA	NA

Source: own calculation based on [8;9]

04| Conclusion and outlook

- Average daily lighting hours in grid-connected areas **significantly** higher than in non-grid connected (but “pre-electrified”) areas
- Average daily lighting hours on absolute level affected by outages- irrespective of source, but more affected by TANESCO outages
- Interconnection between mini-grid and main grid counterbalances outage effects on average daily lighting hours on absolute level

04| Conclusion and outlook

- Further research:
  - ➢ Additional data from households collected from main-grid connected areas to study the impacts of outages
  - ➢ More refined analysis to reflect seasonality of outages
  - ➢ More profound statistical methods to allow for more robust results, e.g. Propensity Score Matching to identify control and research group
  - ➢ Inclusion of more socio-economic indicators and parameters reflected in the Multi-Tier-Framework
  - ➢ Effects on Small and Medium Enterprises

05| References

[1] The World Bank, World Development Indicators, http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators, accessed online on 05.01.2018.

[2] UNDP, Human development report 2016- Human development for everyone , New York, United Nations Publications, 2016.

[3] International Energy Agency (IEA) and the World Bank, Sustainable Energy for All - Global Tracking Framework 2017- Progress toward Sustainable Energy, 2017.

[4] African Development Bank Group, Renewable Energy in Africa-Tanzania Country Profile 2015, 2015.

[5] Odarno, Lily; Sawe, Estomih; Swai, Mary; Katyega, Maneno J.J.; Lee, Allison Christine, Accelerating mini-grid deployment in Sub-Saharan Africa : Lessons from Tanzania., TaTEDO, World Resources Institute, 2017.

[6] Greacen, Chris; Engel, Richard; Quetchenbach, Thomas, A Guidebook on Grid Interconnection and Islanded Operation of Mini-grid Power Systems up to 200 Kw. Best Practices for Interconnection, Schatz Energy Research Center, Humboldt State University, Arcata, CA, and Lawrence Berkeley National Laboratory, Berkeley, CA, 2013.

[7] The World Bank, Beyond Connections: Energy Access Redefined (Presentation), 2017.

[8] Groth, Annika, Comparison of (pre-) electrification statuses based on a case study in Tanzania, Conference Paper, The 11th Conference on Sustainable Development of Energy, Water and Environment Systems – SDEWES Conference, Lisbon, 2016.

[9] Rift Valley Energy, June 2017.

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